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DNA EM 1 Capabilities of Nuclear Weapons

by Philip J. Dolan

Topics	Nuclear Weapons, Effects of Nuclear Weapons, Capabilities of Nuclear Weapons, EM-1, DNA EM 1
Collection	manuals_various; manuals; additional_collections
Language	English

Philip J. Dolan (Editor), Capabilities of Nuclear Weapons, Stanford Research Institute, Defense Nuclear Agency Effects Manual 1, DNA EM 1, 1972, with page updates Change 1 (1978) and Change 2 (1981). Declassified in 1989 with some deletions. Note that this is Part 1, Phenomenology, 835 pages. There is a separate Part 2, Damage Criteria, which gives data on damage and effects caused by the various phenomena. This manual was first issued in July 1951 as TM 23-200, Capabilities of Atomic Weapons. It was renamed Capabilities of Nuclear Weapons in 1964. The current version is 22 volumes long (Harold L. Brode's 1992 edition), with a separate volume for each chapter. A condensed summary of declassified data was issued in 1996 (John A. Northrop's Handbook of Nuclear Weapons Effects Abstracted from EM-1). Revisions continue. Discussion: http://glasstone.blogspot.co.uk/ See also: The effects of the atomic bomb on Hiroshima, Japan (the secret U.S. Strategic Bombing Survey report 92, Pacific Theatre) located at: http://archive.org/details/TheEffectsOfTheAtomicBombOnHiroshima

The EM-1 manual's limitations are discussed at https://www.nukegate.org/ In particular, it was recognised by John von Neumann and others during the Manhattan Project that the act of doing work on a city absorbs blast energy, and Penney later proved this to be the case in both Hiroshima and Nagasaki by measuring the reduction in peak overpressure (from damage done by crushed petrol cans, etc) compared to British nuclear tests on unobstructed terrain at Maralinga (Penney et al., 1970). The energy absorbed from both the overpressure and dynamic pressure loading of a blast wave in pushing (i.e. oscillating in the elastic range) and/or damaging buildings (i.e. the larger soak up of energy in the bigger plastic deformation range, particularly for ductile buildings with steel frames or reinforced concrete) is readily calculated since a deflection of a building's centre of mass by "x" metres requires energy E = Fx = PAx, where P = pressure and A = area. The Northrop 1996 book gives the required data for calculating this energy for a range of buildings on pages 521-5, e.g. Figure 15.7 (where energy absorbed is proportional to the area under the load-ductility ratio "curve") and Table 15.6 (giving oscillation periods, static yield resistance pressures, and ductility ratios for damage for 15 kinds of building). The maximum deflection of a building at a particular distance is calculated from the equation 6.105.1 on page 283 of the 1957 edition of Glasstone's Effects of Nuclear Weapons (not present in later editions!), or from Bridgman's 2001 Introduction to the physics of nuclear weapons effects (DTRA limited edition). Whereas Northrop's 1996 EM-1 Fig. 15.20 shows that a multistorey reinforced concrete building is 50% likely to collapse at 2.7 km ground range from a 1 megaton surface burst (on unobstructed desert terrain), this range could be reduced massively in a real city where intervening buildings absorb most of the blast and radiation (a fact ignored in Western nuclear test data analysis such as Glasstone and EM-1).

EM-1 is therefore more applicable to military targets in open terrain than civilian cities, although it does contain some corrections for shielding in typical real terrain. For example, Northrop's 1996 EM-1 Fig. 16.18 shows thermal exposures in a 1 metre high wheat stand, 4 km from a 550 kt burst at 400 metres altitude: the "theoretical" (Glasstone and Dolan type) free-field thermal exposure is 40 cal/cm^2, but this falls to just 0.2 cal/cm^2 at ground level, showing a shielding effect. A city skyline is even more effective at this sort of shielding, and Figs. 16.16 and 16.17 shows that forests also provide significant shadowing for wide angles, unless the burst is directly overhead. For example, for 1,100 trees/acre of spruce trees there is zero exposure if the fireball's elevation angle above the horizon is 20 degrees or less! Under such conditions, dry leaf litter on the forest floor will not burn regardless of the "free field" exposure calculated from unobstructed line-of-sight assumptions by Glasstone and Dolan! This shadowing problem has obvious major implications for both "firestorm" and "nuclear winter" (firestorm soot cloud) anti-nuclear propaganda efforts used to justify our disarmament.

Evidence of such resistance of forests to nuclear weapons thermal radiation is in Figs. 6.24a and 6.24b in Glasstone's 1957 Effects of Nuclear Weapons (photos removed from later editions, but identified in the de-classified film Military Effects Studies on Operation Castle, as well as Fons and Storey's report Operation Castle, project 3.3, blast effects on tree stand, Figs. 3.2 and 3.8): the former shows the unburned forest stand at 9,300 ft from ground zero on Uncle Island, Bikini Atoll, for 110 kt Castle-Koon in 1954 after 3.8 psi peak overpressure, and the latter shows the unburned forest stand at 62,500 ft from ground zero on Victor Island, Bikini Atoll, for 14.8 Mt Castle-Bravo in 1954 after 2.4 psi peak overpressure. Some blast damage occurred to the trees, but there was no fire. Real world shadowing, and realistic 50-80% humidity of most targets near water (such as most coastal cities, or cities beside large lakes or rivers like Detroit and London), reduces ignition risks contrary to data from low-humidity Nevada tests such as Encore in 1953 (19% humidity!).

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